

LXIV. *A Series of Astronomical Observations made at the Observatory of the Marine at Paris, to wit, 1°. Observations of Jupiter's Satellites in the Years 1767 and 1768. 2°. Observations on the Shadows of Jupiter's Satellites. 3°. On the Variation of the Belts on the Disc of that Planet. 4°. Observation of a Spot on the Disc of the 3d Satellite. 5°. Observation of the Belts of Saturn. 6°. Observation of the Moon's Passage over the Pleiades, in 1767. 7°. Observation of a partial Eclipse of the Moon, January 3, and of a total one, December 23, 1768. 8°. Observations of Two Auroræ Boreales, August 6, and December 5, of the same Year. By M. Mesfrier, Astronomer of the Marine, F. R. S. and of the Academies of Holland and Italy.*

Observations of Eclipses of Jupiter's 4 Satellites, made at Paris, in the Observatory of the Marine, in the Year 1767, with an excellent Gregorian Telescope of 30 Inches Focus, the great Speculum 6 Inches Diameter, and the magnifying Power 104 Times.

1767		True time		
		h	'	
Jan.	25	11	18	17
I. 4. Sky serene. $\gamma$ well defined, the satellite 12' losing its light, during the two last of which it was extremely small. $\gamma$ 28° high in the east. Good observation.				

1767

1767	True time			
	h	'	"	
Jan. 25	15	9	57	E 4. Sky serene. $\gamma$ $47^\circ$ high in the west. Good observation. In both I kept $\gamma$ without the field of the telescope, to view the satellite the better.
26	15	34	34	I. 1. Clear sky. $\gamma$ well defined, $46^\circ$ high in the west. Good observation.
29	10	18	7	I. 2. Serene. $\gamma$ well defined, $22^\circ$ high in the east. Good observation.
Febr. 2	17	27	13	I. 1. $\gamma$ well defined, $31^\circ$ high in the west. The satellite extremely small for a minute. Good observation.
19	17	57	56	I. 2. Sky serene round $\gamma$ , being $16^\circ$ high westward. Good observation.
March 8	8	31	35	I. 1. Clear sky. The satellite disappeared touching the disc of $\gamma$ . Doubtful to some seconds, the opposition being this night at $10^h 49' 4''$ . At $10^h 29' 4''$ the satellite begins to appear at $\gamma$ 's eastern limb; at $10^h 51' 34''$ half out; at $10^h 51' 34''$ quite separated from $\gamma$ 's limb.
20	7	7	26	E. 2. Clear sky about $\gamma$ . The satellite emerged at $\frac{1}{3}$ of the Planet's diameter. $\gamma$ $25^\circ$ high eastward. Good observation.
April 9	7	29	50	E. 1. Serene; but the observation doubtful to some seconds, from the proximity of $\gamma$ to the Moon and the horizon.
10	14	58	18	E. 2. Clear sky; but $\gamma$ near the horizon and the Moon. Observation doubtful to 5 or 6 seconds. The satellite emerged at $\frac{1}{3}$ of a diameter from the Planet. $\gamma$ $15^\circ$ high westward.
28	9	32	10	E. 2. Clear sky. $\gamma$ well defined. The satellite emerged $\frac{3}{4}$ of a diam. from $\gamma$ , which was $47^\circ$ high. Good obs.

1767	True time h ' "			
April 29	10	13	29	E. 3. Clear sky. $\mu$ well defined. The satellite already emerged, perhaps for $\frac{1}{4}$ of a minute; it recovered not its full light till 4' after. The emersion was a diameter from $\mu$ .
May 5	12	9	39	E. 2. Clear sky. $\mu$ well defined. Satellite emerged at more than a diameter from $\mu$ , being then $25^\circ$ high westward. Good observation.
6	11	17	37	I. 3. Sky much clouded. $\mu$ seen through thin clouds; but I think the observation may be depended on to 10 or 12 seconds.
Dec. 21	18	34	32	I. 3. Clear sky. $\mu$ well defined. Satellite entered the shadow 1 diameter from $\mu$ , after having been 2' extremely small. Good observation.
23	14	43	47	I. 1. Clear sky; but $\mu$ near the horizon, and ill defined. However, I esteem the observation a good one. The satellite emerged $\frac{1}{3}$ of a diameter from $\mu$ , being then $12^\circ$ above the horizon.
March 15	12	41	48	E. 1. At Colombes, near Paris, $20\frac{2}{3}$ seconds of time west of the Royal observatory. The satellite out of the shadow, with a ten feet refractor of Dollond, magnifying 120 times. Good observation.
April 16	9	27	3	E. 1. At Colombes; serene sky; the satellite emerged at $\frac{1}{2}$ diameter from $\mu$ ; with a Dollond's refractor of ten feet.
May 30	9	14	47	E. 2. At Calais; sky serene round $\mu$ , with a $3\frac{1}{2}$ feet refractor of Dollond, with a triple object-glass. The satellite emerged 1 diameter from the Planet, a little above the 4th satellite. Good observation.

1767	True time			
	h	'	"	
June 1	9	51	40	E. 1. At Calais; sky serene; $\gamma$ well defined. The satellite emerged at the distance of $\frac{1}{2}$ a diameter. Same refractor. Good observation.
8	11	24	4	I. 4. At Dunkirk; serene sky; but $\gamma$ near the horizon; the belts, however, appeared plain, and I think it a good observation. The satellite was more than 6' losing its light. Dollond's $3\frac{1}{2}$ feet refractor.
	11	47	54	E. 1. At Dunkirk; serene sky; but $\gamma$ very near the horizon, and ill defined. Doubtful observation.
				Observations on the shadow of Jupiter's satellites, and the variations of his belts, at the Observatory of the Marine, with a Gregorian reflector, of 30 inches focus, magnifying 104 times.
1767				
Febr. 19	12	58	46	The shadow of the first satellite appeared entirely on $\gamma$ 's disc, and proceeded along the upper part of the middle belt.
	13	18	3	The satellite itself entered half way on $\gamma$ 's disc, following its shadow on the same belt.
	14	1	7	The shadow of the fourth entirely entered on $\gamma$ 's disc, and running along the lower edge of $\gamma$ 's upper belt.
	15	3	57	The shadow of the first satellite in internal contact with $\gamma$ 's limb.
	15	7	27	The shadow of the first quite off $\gamma$ 's limb.
	15	25	23	The first beginning to go off the disc.
	15	29	53	The first gone off, but still in external contact with the limb.
	15	29	53	The shadow of the fourth seems advanced one half of its path over the disc.
	16	29	43	The shadow of the fourth seems to be two of its own diameters from $\gamma$ 's limb.

1767	True time	
	h	' "
Febr. 19	16 42 41	The shadow of the fourth, at least, one of its own diameters from $\mathcal{U}$ 's limb.
	16 54 39	The shadow of the fourth looks oval, and touches $\mathcal{U}$ 's limb.
	17 5 35	The shadow of the fourth quite off $\mathcal{U}$ 's western limb.
	17 5 35	The fourth satellite almost touches $\mathcal{U}$ 's eastern limb.
	17 13 34	The fourth satellite entering on $\mathcal{U}$ 's disc, and forming an indentation on his limb.
	17 35 32	The fourth satellite quite entered, but not so visible on the disc as the first.

The shadow of the fourth seemed larger than that of the first; it was also more perceptible; owing, perhaps, to the shadow of the first running along the upper side of the middle belt, which was darker and more conspicuous than the upper belt, where the shadow of the fourth was. It was an easy matter to form a judgment of their differences, as the two shadows were at the same time seen on  $\mathcal{U}$ 's disc. At  $6\frac{1}{4}^h$  in the morning the sky became clouded, so that the egress of the fourth from the disc could not be observed.

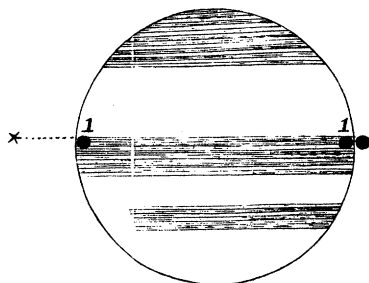
The figure n° 1 (TAB. XIX) represents  $\mathcal{U}$ 's disc at the moment of the entry of the shadow of the first satellite; the upper part was shaded, but less sensibly than the middle belt, which was blackish, and of a darker hue in some parts than in others. Below this middle belt, another was visible, which terminated at about two-thirds of  $\mathcal{U}$ 's diameter. It was narrow, but as distinguishable as the middle belt.

The fig. n° 2 represents the shadow of the fourth satellite, which passed along the upper belt less distinct than the middle one. At  $3^h 11'$  the lower narrow belt was not to be seen; the middle belt was also altered, being of various shades, and different from that represented in fig. 1. at the time of the immersion of the shadow of the first satellite.

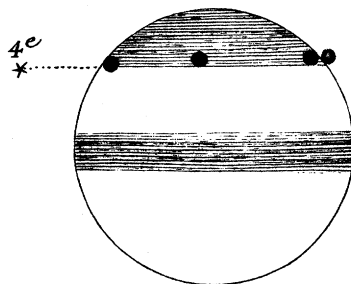
The fig. n° 3 represents the shadows of the first and fourth satellites, viewed at the same time.

The fig. n° 4 represents  $\mathcal{U}$ 's belts: the upper belt was the same as in fig. n° 1: the middle belt was likewise the same: the

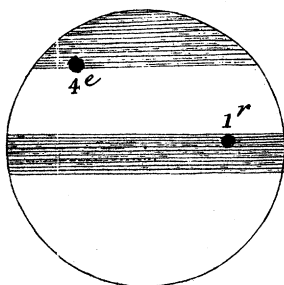
I.



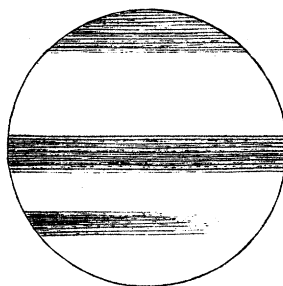
II.



III.



IV.



the narrow belt, which had disappeared, appeared again on the eastern side. At  $4^h 30'$  it was advanced  $\frac{1}{2}$  of the diameter. At  $5^h 58'$  it extended almost from one limb to the other, as narrow and sensible as in fig. n<sup>o</sup> 1.

The 6th of September, 1760, having computed the ingress of the third satellite on  $\mathcal{U}$ 's disc, I viewed the Planet with a Gregorian reflector of 30 inches focus, magnifying 104 times. At  $7^h 4''$  I perceived at the center of the Planet, on the lower belt, a black spot, pretty round, and nearly of the size of the shadow of the first satellite. I guessed this spot to be the shadow of the third. I observed its progress, and being got on  $\frac{2}{3}$  of  $\mathcal{U}$ 's disc, at  $8^h 13'$  I perceived the shadow of the third just entered on  $\mathcal{U}$ 's eastern limb, and was larger than that I observed before, which made me to imagine, that the first shadow might be a spot on the very disc of the third satellite. I went on with my observations, and found, that the nearer this shadow approached the western limb of  $\mathcal{U}$ , the more it was diminished in size, and I lost sight of it before it had got to the Planet's limb. Lastly, at  $9^h 26'$ , the third satellite was half emerged, and formed an indentation on the disc. I was then well satisfied, that the observed spot was on the disc of the third satellite; and I took notice, that this satellite, when quite emerged, was not so luminous as usual.

The 28th of March, 1766, having viewed Saturn with the same achromatic reflector of 10 feet 7 inches focus, I perceived on his globe two darkish belts; they were indeed extremely faint, and difficult to be discerned, directed, however, in a right line parallel to the longest diameter of Saturn's ring.

The several observations here recited are extremely nice; and it were to be wished that astronomers, concerned in observations, might be accommodated with achromatic telescopes, of the most perfect construction; as such are the only instruments whereby a great knowledge of the celestial bodies can be acquired, for the improvement and perfection of astronomy.

Observations of the Moon's Transit over the Pleiades, in 1767,  
at the Observatory of the Marine.

1767	True time h ' "			
Sept. 12	14	11	42	Imm. of * <i>b</i> , Electra, at the illuminated limb of the Moon.
	15	0	49½	Imm. of * <i>d</i> , Merope.
	15	6	8	Imm. of * <i>e</i> , Maia, near the limb, as it were shaving it.
	15	14	56	Emerf. of * <i>s</i> , Celeno, doubtful to 5 or 6 seconds, from thin clouds.
	15	24	49	Emerf. of * <i>b</i> , Electra. Good.
	15	34	11	Emerf. of * <i>n</i> , Alcyone. Good.
	15	47	39	Emerf. of * <i>c</i> , Maia. Good to a second.
	15	54	31	Emerf. of * <i>d</i> , Merope. Doubtful.
				Looking into the telescope, was visible; though but a small time emerged.
	16	51	11	The Moon clear of clouds, <i>n</i> appeared; it had emerged a few minutes.
Nov. 6	17	2	10	Conjunction of * <i>f</i> Atlas. It passed very near the Moon's limb, being only 10 parts of the micrometer from it, equal to 9 seconds.
	11	9	50	Imm. of * <i>d</i> , Merope. Doubtful to 2 or three seconds, from the great light of the Moon.
	11	57	57½	Imm. of * <i>n</i> , Alcyone. Good to a second.
	12	11	55½	Emerf. of * <i>d</i> , Merope. Good to a second.
				The * <i>s</i> was effaced by the light of the Moon.
	12	31	59	Imm. of * <i>f</i> , Atlas. Good.
	12	45	50	Emerf. of * <i>n</i> , Alcyone. It was already out, perhaps half a minute.
	13	42	25½	Emerf. of * <i>b</i> , Pleione. The immersion could not be observed, for the great light of the Moon. The emergence good to a second.



1767	True time			
	h	'	"	
Nov. 6	13	43	28½	Emerf. of * <i>f</i> , Atlas. Good to half a second.
Dec. 31	4	32	57	Imm. of * <i>d</i> , Merope.
	4	40	18½	Emerf. of * <i>d</i> , Merope.
	5	14	0	Conjunction of * <i>n</i> , Alcyone 280 parts of the micrometer = 4' 5" from the Moon's upper limb.
	5	27	58	Imm. of * <i>f</i> , Atlas, into the obscure limb of the Moon. Doubtful to 2".
	6	20	20	Emerf. of * <i>f</i> , Atlas, from the illumined limb of the Moon againft Cleomedes. Good. * <i>b</i> could not be observed for moon-light.

Observations of the eclipses of Jupiter's satellites, made at the Observatory of the Marine at Paris, in the year 1768, with a Gregorian reflector, of 30 inches focus, magnifying 104 times.

1768	True time			
	h	'	"	
Jan. 31	12	53	22	Imm. 1. Sky serene. $\mathcal{U}$ well defined. Good observation.
Feb. 2	18	4	36	Imm. 3. Sky serene. The satellite extremely small for two minutes.
	14	16	39 24	Clouds covered $\mathcal{U}$ . The first satellite had then lost much of its light: 28" after $\mathcal{U}$ re-appeared, but the first satellite was no longer seen. I put the immersion at 16 <sup>h</sup> 39' 50".
March 1	14	57	56½	Imm. 1. Sky serene. The Moon above the horizon, which did no great harm. $\mathcal{U}$ was well defined; the satellite very small for 45", it entered the shadow at $\frac{1}{3}$ of a diameter from $\mathcal{U}$ . $\mathcal{U}$ 35° high westward. Good observation.
	10	11	22 15	Imm. 1. Sky serene. $\mathcal{U}$ well defined. For 30" the satellite was very small. It entered the shadow at $\frac{1}{4}$ diam. from $\mathcal{U}$ . $\mathcal{U}$ 26° high east. Good observ.

1768	True time			
	h	'	"	
April 3	0	55	34	Imm. 2. Sky serene round $\gamma$ , which was well defined. The satellite entered the shadow near $\gamma$ 's limb. I esteem it a good observation.
27	8	35	11 $\frac{1}{2}$	Emerf. 1. Sky serene. $\gamma$ pretty well defined: the Moon, though near him, did not much incommode. The satellite emerged $\frac{1}{2}$ diameter from $\gamma$ , then $32^{\circ}$ high eastward. Good observation.
May 4	10	31	0	Emerf. 1. Sky serene. $\gamma$ well defined. Satellite emerged $\frac{1}{2}$ diameter from $\gamma$ , then $36^{\circ}$ high, having lately passed the meridian. Good observation.
5	13	7	51	Emerf. 2. $\gamma$ , among interstices of clouds, was not well defined; the belts not distinct. Satellite emerged $\frac{1}{2}$ diameter from $\gamma$ , then $22^{\circ}$ high. Pretty good observation.
11	12	26	15	Emerf. 1. $\gamma$ well defined. Good observation.
20	8	49	54	Emerf. 1. Sky pretty clear, and $\gamma$ well defined. With a Dollond's 5 feet refractor with a double object glass. Satellite emerged $\frac{1}{2}$ diameter from $\gamma$ . The satellite very small, and the observation good.
27	10	03	50	Imm. 3. Sky serene. $\gamma$ well defined. Satellite continued very small for $3'$ . It entered the shadow at $\frac{1}{4}$ diameter from $\gamma$ , then $32^{\circ}$ high westward. Good observation.
	10	43	14	Emerf. 1. Sky still serene, and $\gamma$ well defined. Satellite emerged $\frac{1}{2}$ diameter from $\gamma$ , then $30^{\circ}$ high westward. Good observation.
	12	5	42	$\gamma$ just free of clouds. The third satellite appears in nearly its full lustre.
June 3	12	37	39	Emerf. 1. Sky serene; but $\gamma$ too near the horizon; and, being among vapours, ill defined. Satellite emerged

1768	True time			
	h	'	"	
June 19	10	53	43	$\frac{1}{3}$ diameter from $\mathcal{U}$ , then $10^\circ$ high. Good to a few seconds. Emerf. 1. Sky partly clouded, but $\mathcal{U}$ pretty bright at the time of observation. Satellite emerged $\frac{2}{3}$ diameter from $\mathcal{U}$ , then $17^\circ$ high. Good to a few seconds.
July 5	9	8	5	Emerf. 1. Sky clear. $\mathcal{U}$ well defined. The emerfion at $\frac{1}{3}$ diameter from $\mathcal{U}$ , $22^\circ$ high westward. A good observation.
28	9	20	20	Emerf. 1. Clear sky, but $\mathcal{U}$ only $5^\circ$ high westward. The Planet ill defined, though the belts were plain enough. A doubtful observation.

Observation of a partial Eclipse of the Moon, on the night between the 3d of January, 1768, at the Observatory of the Marine at Paris, with a four Feet Newtonian Reflector, magnifying 66 Times, armed with a Micrometer.

1768	True time			
	h	'	"	
Jan. 3	11	50	20	The Moon's centre passed the meridian. 3 II. passed. $1^\circ 27' 41''$ , the difference between the altitude of the Moon's upper limb and that of the star, the star being lower.
	12	8	38	

1768. January 3. True time.	Uneclipsed part of the Moon.	The part eclipsed.	
h ' "	' "	' "	
15 14 40			The penumbra sensible. Very strong. The eclipse begins. Immersion of Tycho.
15 18 49			
15 22 48			
15 28 47			
15 30 22	27 15	4 5	
15 36 46	25 52	5 28	
15 49 44	22 43	8 37	
15 54 43	22 8	9 12	

1768. January 3. True time.	Uneclipsed part of the Moon.	The part eclipsed.	
h ' "	' "	' "	
16 0 12	20 46	10 34	
16 4 40	20 14	11 6	
16 9 34			Fracaſtorius enters the ſhadow.
16 10 40			The ſame entirely in the ſhadow.
16 10 40			Mare Neſtaris enters the ſhadow.
16 12 39	19 24	11 56	
16 15 39	31 20		The Moon's diameter.
16 18 38	18 47	12 33	
16 21 38			Mare Neſtaris half entered.
16 23 8	18 40	12 40	
16 24 38			Mare Neſtaris totally in the ſhadow.
16 26 37	18 31	12 49	
16 26 37			Langrenus is entered into the ſhadow.
16 31 36	18 18	13 2	
16 35 35			Mare Imbrium nearly half entered.
16 38 34	18 20	13 0	
16 40 34	18 22	12 58	
16 46 34	18 38	12 42	
16 48 33	18 49	12 31	The Moon in a miſt, the ſhadow ill defined.
17 3 30	20 15	11 5	The Moon pretty clear, Mare Humorū got out of the ſhadow 7' or 8'.
17 5 0			Mare Nubium clear of the ſhadow.
17 7 29	21 17	10 3	
17 12 28			Mare Neſtaris begins to emerge.
17 14 28	22 12	9 8	
17 14 58			Tycho half out.
17 16 57			Mare Neſtaris half out.
17 16 57	23 9	8 11	
17 17 27			Tycho clear of the ſhadow.
17 21 27	24 13	7 7	
17 25 26			Fracaſtorius out of the ſhadow.
17 26 26			Mare Neſtaris out of the ſhadow.
17 27 56	25 18	6 2	
17 34 55	26 57	4 23	

1768. January 3. True time. h ' "	Parts en- lightened.	Parts e- clipsed.	
17 36 25	' "	' "	Mare Imbrium out of the shadow, which did not cover one half of it.
17 39 53	28 57	2 23	
17 43 23	29 42	1 38	
17 43 53			The Moon's limb begins to be visible.
17 45 53	29 59	1 21	
17 46 54			End of the eclipse.
17 51 22	31 32		Moon's diameter.
17 55 20			Much penumbra still left.
17 57 30			Now as before the eclipse began.
18 14 20			Now little or nothing sensible.

During the night of the eclipse the sky was greyish, and overspread with thin clouds; but the stars might be discerned. The shadow pretty well defined, and would have been much more if the sky had been clear. The cold was considerable all night long, the thermometer marking 11 degrees below 0, on Reaumur's scale.

Observation of the total Eclipse of the Moon, the 23d of December, 1768, in the Evening, at the same Observatory of the Marine, with the same Newtonian Reflector of  $4\frac{1}{2}$  feet. The Sky serene during the 23d Day, but some Clouds in the West during the Eclipse; in the East serene, with a small Mist, which was favourable; the Shadow well defined. I had no View of the Moon, at the Horizon, because of elevated Land Objects.

1768. Dec. 23. True time. h ' "	Parts en- lightened.	Parts e- clipsed.	
4 27 0	' "	' "	The Moon beginning to appear over the church of Nôtre Dame, seeming to the bare eye half way eclipsed. Tycho already some minutes emerged.

1788. December 23. True time. h ' "	Parts en- lightened. ' "	Parts e- clipsed. ' "	
4 35 36	15 4	17 29	
4 39 3	17 6	15 27	
4 41 0	18 16	14 17	
4 43 7	19 58	12 35	
4 44 30			Mare Serenitatis quits the shadow.
4 44 39			Dionysius quits the shadow.
4 46 14	21 41	10 52	
4 47 54			Mare Serenitatis half out.
4 49 34	23 20	9 13	
4 49 48			Mare Tranquillitatis half out.
4 51 8			Mare Serenitatis quite out.
4 52 18	24 31	8 2	
4 54 18			Mare Tranquillitatis clear of the shadow.
4 55 26	26 40	5 53	
4 56 29			Mare Imbrium half out.
4 58 4			Mare Crisium half out.
4 59 7	28 57	3 36	
5 0 34			Mare Crisium and Mare Imbrium quite out.
5 2 10	30 52	1 41	
5 2 50			The Moon's limb beginning to be discernible.
5 3 36			The end of the shadow, or of the eclipse.
5 4 6			Yet more certain.
5 5 6			Strong penumbra.
5 5 46			Yet very sensible.
5 6 45	32 32		The Moon's diameter.
5 8 45			The penumbra still remains.
5 9 45	32 34		The Moon's diameter.
5 15 44			A small matter of the penumbra still remaining.